Docket No. 0756-1553

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of
Toshimitsu Konuma et al.)
Serial No. 08/698,204) Art Unit: 2871
Filed: August 14, 1996) Examiner: K. Parker
For: ELECTRO-OPTICAL DEVICE)

VERIFICATION OF TRANSLATION

Honorable commissioner of patents and Trademarks
Washington, D.C. 20231
Sir:

I, Ikuko Noda, 3-G, 1551, Hase, Atsugi-shi, Kanagawa-ken 243-0038 Japan, a translator, herewith declare:

that I am well acquainted with both the Japanese and English Languages;

that I am the translator of the attached translation of the Japanese Patent Application No. 5-256571 filed on September 20, 1993; and

that to the best of my knowledge and belief the following is a true and correct translation of the Japanese Patent Application No. 5-256571 filed on September 20, 1993.

I further declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Date: this 18th day of June, 1999

Ikuko Noda

Name: Ikuko Noda

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[Inventor]
[Address] 398, Hase, Atsugi-shi, Kanagawa-ken c/o Semiconductor Energy Laboratory Co., Ltd.
[Name] Toshimitu KONUMA
[Inventor]
[Address] 398, Hase, Atsugi-shi, Kanagawa-ken c/o Semiconductor Energy Laboratory Co., Ltd.
[Name] Takahiro TSUJI
[Inventor]
[Address] 398, Hase, Atsugi-shi, Kanagawa-ken c/o Semiconductor Energy Laboratory Co., Ltd.
[Name] Kouji MORIYA
[Applicant]
[Identification Number] 000153878
[Name] Semiconductor Energy Laboratory Co., Ltd.
[Representative] Shunpei YAMAZAKI

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[List of Attachment]
[Attachment] Specification 1
[Attachment] Drawing 1
[Attachment] Abstract 1

[NAME OF DOCUMENT] Specification
[TITLE OF INVENTION] LIQUID CRYSTAL DISPLAY DEVICE
[WHAT IS CLAIMED IS:]

1. A liquid crystal display device comprising:
a display region and a drive circuit region comprising a drive circuit for controlling the display in said display region provided on a single substrate;
a counter substrate opposed to said substrate;
a sealing material by which said display region and the drive circuit region are partitioned; and
a liquid crystal material between said substrates,
wherein said counter substrate is opposed to both of said display region and said drive circuit region.

2. A liquid crystal display device comprising:
a display region and a drive circuit region comprising a drive circuit for controlling the display in said display region provided on a single substrate;
a counter substrate opposed to said substrate;
a sealing material by which said display region and the drive circuit region are partitioned; and
a liquid crystal material between said substrates,
wherein said counter substrate is opposed to both of said display region and said drive circuit region, and at least a portion of a periphery of the drive circuit region is provided with the sealing material.

3. A liquid crystal display device comprising:
a display region and a drive circuit region comprising a drive circuit for controlling the display in said display region provided on a single substrate;
a counter substrate opposed to said substrate;
a sealing material by which said display region and the drive circuit region are partitioned; and
a liquid crystal material between said substrates,
wherein said counter substrate is opposed to both of said display region and said drive circuit region, and a resin material is incorporated between at least the counter substrate and the drive circuit region.

4. A liquid crystal display device comprising:
a display region and a drive circuit region comprising a drive circuit

for controlling the display in said display region provided on a single substrate;

a counter substrate opposed to said substrate;

a sealing material by which said display region and the drive circuit region are partitioned; and

a liquid crystal material between said substrates,

wherein said counter substrate is opposed to both of said display region and said drive circuit region, and at least a portion of a periphery of the drive circuit region is surrounded by a sealing material and a resin material is incorporated between the counter substrate and the drive circuit region at the surrounded region.

5. The device of claim 1, 2, 3 or 4 wherein a drive circuit is provided on the counter substrate at a region opposed to the drive circuit region.

[DETAILED DESCRIPTION OF INVENTION]

[0001]

[PRIOR ART]

Conventionally, in liquid crystal display devices, particularly, in active matrix type liquid crystal display devices having a matrix structure wherein active elements such as thin film transistors are formed on each of the pixels, there has been known a monolithic type structure comprising drive circuits, for controlling the signal applied to each of the pixels, provided integrated to the substrate having thereon the active elements connected to each of the pixels. The drive circuit is generally formed simultaneously with the fabrication of an amorphous silicon thin film transistor for the display portion constituting the matrix, and then crystallized by irradiating with laser and the like only to the drive circuit portion. In this manner, the TFTs were converted into crystallized silicon thin film transistors.

[0002]

In the devices having this structure, as shown in Fig. 1, a counter substrate 2 opposed to a substrate 1 having thereon the drive circuit is extended to cover only a display region 5 comprising a liquid crystal material 3, and no measure is taken for a drive circuit portion 6 except for covering with a resin 7 or the like.

[0003]

[PROBLEMS OF THE PRIOR ART]

However, when an external force or the like is applied to the drive circuit portion in the conventional constitution, the drive circuit is easily

damaged, so that the breakdown is caused.

[0004]

[PROBLEMS TO BE SOLVED BY INVENTION]

In the liquid crystal display device comprising both a display portion and a drive circuit portion on a single substrate, the present invention provides a constitution in which the drive circuit portion is protected, thereby high reliability is improved.

[0005]

[MEANS TO SOLVE THE PROBLEMS]

In order to solve the above problems, the present invention provides a liquid crystal display device comprising:

a display region and a drive circuit region comprising a drive circuit for controlling the display in said display region provided on a single substrate;

a sealing material by which said display region and the drive circuit region are partitioned;

a counter substrate opposed to said substrate; and

a liquid crystal material between said substrates,

wherein said counter substrate is opposed to both of said display region and said drive circuit region.

[0006]

Also, a liquid crystal display device of the present invention comprising:

a display region and a drive circuit region comprising a drive circuit for controlling the display in said display region provided on a single substrate;

a sealing material by which said display region and the drive circuit region are partitioned;

a counter substrate opposed to said substrate; and

a liquid crystal material between said substrates,

wherein said counter substrate is opposed to both of said display region and said drive circuit region, and at least a portion of a periphery of the drive circuit region is provided with the sealing material.

[0007]

Further, a liquid crystal display device of the present invention comprising:

a display region and a drive circuit region comprising a drive circuit for controlling the display in said display region provided on a single substrate;

a sealing material by which said display region and the drive circuit

region are partitioned;

a counter substrate opposed to said substrate; and

a liquid crystal material between said substrates,

wherein said counter substrate is opposed to both of said display region and said drive circuit region, and a resin material is incorporated with between at least the counter substrate and the drive circuit region.

[0008]

Also, a liquid crystal display device of the present invention comprising:

a display region and a drive circuit region comprising a drive circuit for controlling the display in said display region provided on a single substrate;

a sealing material by which said display region and the drive circuit region are partitioned;

a counter substrate opposed to said substrate; and

a liquid crystal material between said substrates,

wherein said counter substrate is opposed to both of said display region and said drive circuit region, at least a part of the periphery of the drive circuit region is surrounded by a sealing material, and a resin material is incorporated between the counter substrate and the drive circuit region at the surrounded region.

[0009]

Also, according to the above constitution of the present invention, the drive circuit is formed on a region opposed to the drive circuit region in the counter substrate.

[0010]

[OPERATION]

A liquid crystal display device of the present invention comprises a display region and a drive circuit region comprising a drive circuit for controlling the display in the display region provided on a single substrate, wherein the drive circuit can be protected from external pressure and shock by a counter substrate opposed to the drive circuit region.

[0011]

Furthermore, a resin material is charged between at least the drive circuit region and the counter substrate, thereby preventing the intrusion of moisture and the like. In this manner, a liquid crystal display device with further improved reliability can be realized.

[0012]

Another drive circuit and the like can be further provided on the region of the counter substrate opposed to the drive circuit region, thereby

a multilayer-structured substrate having a large drive circuit region can be implemented without increasing the substrate area.

[0013]

[EMBODIMENT]

[EMBODIMENT 1]

Referring to Fig. 2 (A), an amorphous silicon TFT was fabricated on a display region 12 of a Corning 7059 glass substrate 10. On a drive circuit region 13 of the substrate 10, a crystalline silicon TFT was fabricated by irradiating a laser beam to an amorphous silicon TFT for its crystallization. If necessary, the crystalline silicon TFT is covered with a passivation film made of, for example, SiN, SiO_2, PSG (phosphosilicate glass), BSG (borosilicate glass), or polyimide to construct a drive circuit. A pixel electrode and the like were formed thereafter on the display region 12 to form a matrix with 640 x 480.

[0014]

Then, as shown in Fig. 2(B), a sealing material 14, more specifically, an ultraviolet-curable resin in this case, was applied to a counter substrate 11 capable of covering the drive circuit region of the substrate opposed, and comprises an ITO (indium tin oxide) formed either on the display region alone or on the entire surface thereof as a counter electrode. Referring to Fig. 2 (B), each of the display region 12 and the drive circuit region 13 may be surrounded separately by screen printing. At this time, an inlet 15 for injecting the liquid crystal material must be formed to the sealing material provided for covering the display region. Also, the entire periphery of drive circuit region need not be surrounded by the sealing material for surrounding the drive circuit region. Otherwise, the display region alone can be surrounded by the sealing material while leaving the drive circuit region uncovered. Furthermore, the sealing material may contain spacers.

[0015]

The substrate 10 and the counter substrate 11 are mated with each other after scattering spacers on the display region of the substrate 10, and an ultraviolet radiation was irradiated thereto for curing.

[0016]

A liquid crystal material 16 was injected into inside of the display region after reducing the pressure of the laminated substrates, and sealed.

[0017]

Fig. 3 illustrates a liquid crystal display device formed in such manner. The liquid crystal display device has far improved strength against external pressure as compared to a conventional device comprising both the display region and the drive circuit on a single substrate wherein

the drive circuit comprising no glass substrate opposed thereto is covered by only a resin and the like. Thus, the drive circuit was sufficiently protected against external force and therefore free from breakage. Moreover, the manufacturing steps can be an extremely simple.

[0018]

[EMBODIMENT 2]

A substrate 10 having thereon a display region and a drive circuit region as well as a counter substrate 11 having thereon a counter electrode were fabricated in the same manner as in Example 1. On the counter substrate 11, a sealing material 14, more specifically, a UV-curable resin in this case, was applied by screen printing as shown in Fig. 4 (A) to cover the display region 12. The sealing material may contain spacers. An inlet 15 for injecting a liquid crystal material must be provided in this step.

[0019]

A resin material 17, such as a UV-curable resin or an epoxy resin, is provided to the portion to be opposed to the drive circuit region 13 by either screen printing or potting, so that the resin material can be charged sufficiently on at least the drive circuit region upon laminating the substrate 10 and the counter substrate 11. The resin material may be the same as that for the sealing material. The sealing material and the resin may be applied not on the counter substrate side, but on the substrate side having thereon the display region and the drive circuit.

[0020]

After scattering spacers on the display region of the substrate 10, the substrate 10 was laminated with the counter substrate 11. The sealing material and the resin on the drive circuit region were cured thereafter.

[0021]

The thus laminated substrates were in vacuum condition, and a liquid crystal material 16 was injected inside the display region and sealed.

[0022]

According to the liquid crystal display device thus obtained as illustrated in Fig. 4 (B), similar to the case in Example 1, the drive circuit can be protected against external force, and the device itself had excellent resistance against intrusion of moisture into the drive circuit region. Accordingly, high reliability can be realized in the liquid crystal display device.

[0023]

[EMBODIMENT 3]

Regarding a substrate 10 having thereon a display region and a drive

circuit as well as a counter substrate having thereon a counter electrode, which were fabricated in the same manner as in Example 1, a sealing material 14, more specifically, a UV-curable resin in this case, was applied by screen printing to the counter substrate 11 to cover the display region 12 by forming an inlet 15 for injecting a liquid crystal material as shown in Fig. 5(A). The sealing material may contain spacers.

[0024]

After scattering spacers on the display region of the substrate 10, the substrate 10 was laminated with the counter substrate 11, thereby the sealing material was cured.

[0025]

Thereafter, laminated substrates were placed under vacuum, and a liquid crystal material 16 was injected inside the display region and sealed.

[0026]

Then, a resin material (a UV-curable resin in this case) was charged in the portion between the substrates under a reduced pressure of from about 0.01 to 10 torr, and the entire structure was placed under normal pressure or under a pressurized state. The resin material was found to intrude into the periphery of the sealing material, and the space between the substrates corresponding to the drive circuit region 13 was charged with a resin material 17. The resin was cured thereafter by irradiating an ultraviolet radiation.

[0027]

In the case that two substrates has the same size, the resin can be mounted on both sides of the substrates, thereby it facilitates the fabrication process. The liquid crystal material can be injected after charging and curing the resin.

[0028]

Similar to Example 2, thus obtained liquid crystal display device illustrated in Fig. 5 (B) is highly reliable having sufficiently high resistance against moisture and the like.

[0029]

[EXAMPLE 4]

Regarding a substrate 10 having thereon a display region and a drive circuit region as well as a counter substrate having thereon a counter electrode fabricated in the same manner as in Example 1, a sealing material 14, more specifically, a UV-curable resin in this case, was applied by screen printing to the substrate 11 to form an inlet 15 for injecting a liquid crystal material and an inlet 18 for injecting a resin as shown in Fig.

6 (A). The sealing material may contain spacers.

[0030]

After scattering spacers on the display region of the substrate 10, the substrate 10 was laminated with the counter substrate 11. The sealing material was cured thereafter.

[0031]

Thereafter, the entire laminated substrates were placed under a reduced pressure of from about 0.01 to 10 torr, and a liquid crystal material 16 and a resin material 17 (a UV-curable resin in this case) were injected into the display region and the region surrounding the drive circuit, respectively, from the inlets 15 and 18. The injection can be effected simultaneously; otherwise, it can be effected separately to prevent mixing of the resin and the liquid crystal material from occurring due to evaporation during the injection.

When the resulting structure was placed under a normal pressure or a pressurized state. The resin material 17 was intrude into the region covered by the sealing material, thereby the space between the substrates in the drive circuit region was filed. Thereafter, an ultraviolet radiation was irradiated to cure the resin.

[0032]

Similar to Examples 2 and 3, thus obtained liquid crystal display device illustrated in Fig. 6 (B) is highly reliable having sufficiently high resistance against moisture and the like, thereby an extremely simple process was realized.

[0033]

In the embodiments, the drive circuit may be provided on both of the substrates as well as on only one substrate. In such a case, the electrical connection between the drive circuits on both of the substrates can be established by using, for example, a silver paste, an electrically conductive spacer, or the like. Also, the liquid crystal material may be of any type such as nematic, smectic, and the like. In the drawings of respective embodiments, the substrates 10 and 11 are drawn in the same size. However, when a counter substrate is formed on a drive circuit region, the size of the both substrates can be changed as desired. When the size of the substrate 10 is increased, electrodes can be more easily connected.

[0034]

In the present examples, an active matrix drive type device using thin film transistors for the display region is illustrated, however, the present invention is also effective to device using non-linear devices such as MIM diodes as well as to simple matrix drive type devices.

[0035]

[EFFECT OF THE INVENTION]

According to the present invention, the liquid crystal display device comprising both a display region and a drive circuit region formed with a drive circuit for controlling the display on a single substrate, in which the drive circuit is protected against external forces and the like. Furthermore, in case of chamfering a plurality of liquid crystal display panels from a large area substrate by applying a scriber to the laminated substrates, the drive circuit could be protected against the impact and the like which is caused by the operation of a scriber. Thus, the present invention enables production of liquid crystal display panels with high production yield.

[0036]

Furthermore, a resin material was charged between the drive circuit region and the counter substrate, thereby reliability of the device was improved by preventing the intrusion of moisture or the like.

[0037]

Also, another drive circuit and the like can be further provided on the region of the counter substrate opposed to the drive circuit region, thereby the device has a multilayer-substrate structure. In this manner, a large drive circuit area can be implemented without increasing the substrate area.

[[BRIEF DESCRIPTION OF THE DRAWINGS]

Fig. 1 shows a conventional liquid crystal display device.

Fig. 2 shows an embodiment of a liquid crystal display device according to the present invention.

Fig. 3 shows an embodiment of a liquid crystal display device according to the present invention.

Fig. 4 shows an embodiment of a liquid crystal display device according to the present invention.

Fig. 5 shows an embodiment of a liquid crystal display device according to the present invention.

Fig. 6 shows an embodiment of a liquid crystal display device according to the present invention.

[Description of Marks]

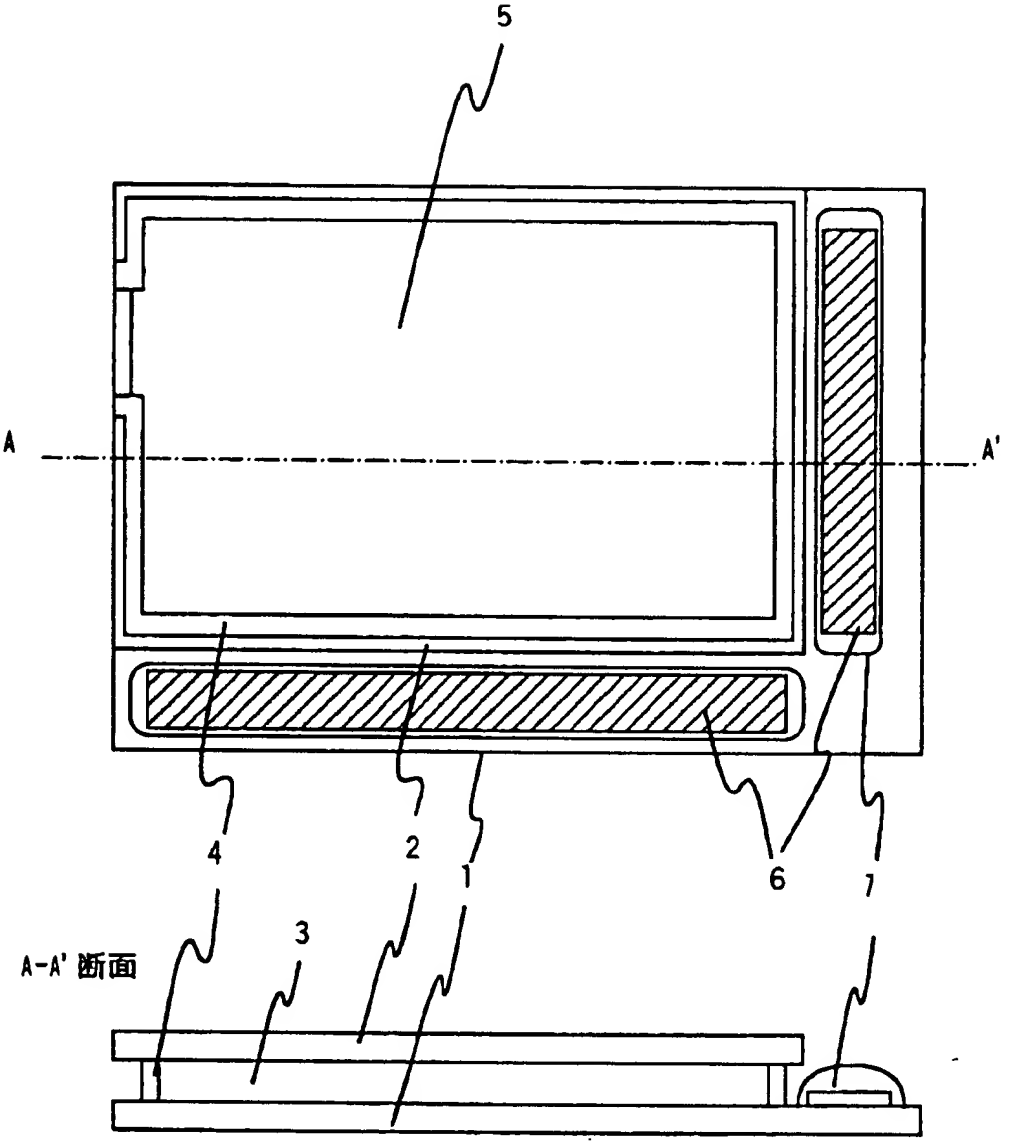
1	substrate
2	counter substrate
3	liquid crystal material
4	sealing material

5	display region
6	drive circuit
7	resin
10	substrate
11	counter substrate
12	display region
13	drive circuit
14	sealing material
15	inlet for injecting a liquid crystal
16	liquid crystal material
17	resin material
18	inlet for injecting a resin

【整理番号】 P002495－09

【書類名】 図面

【図1】



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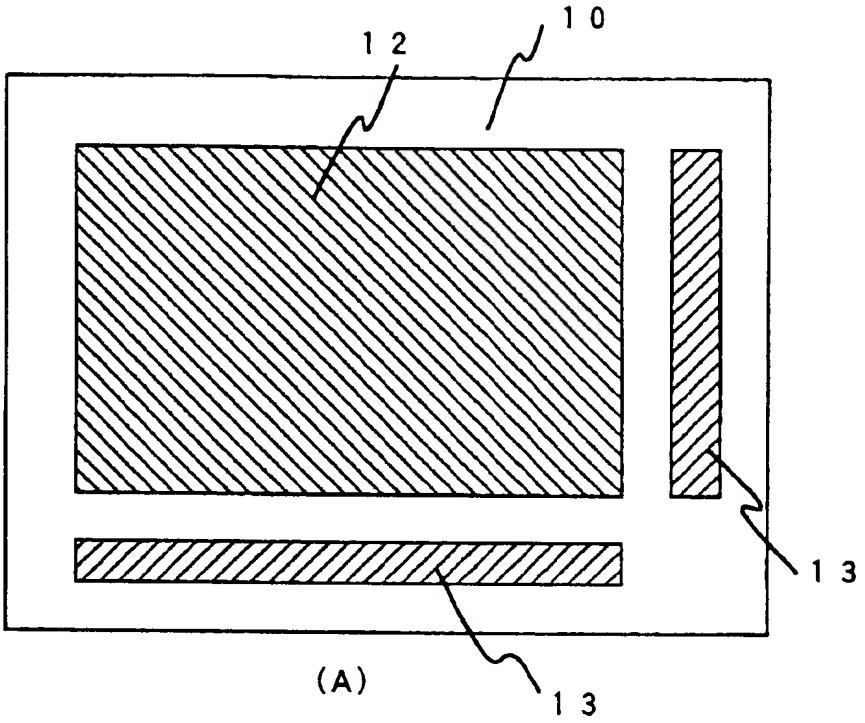

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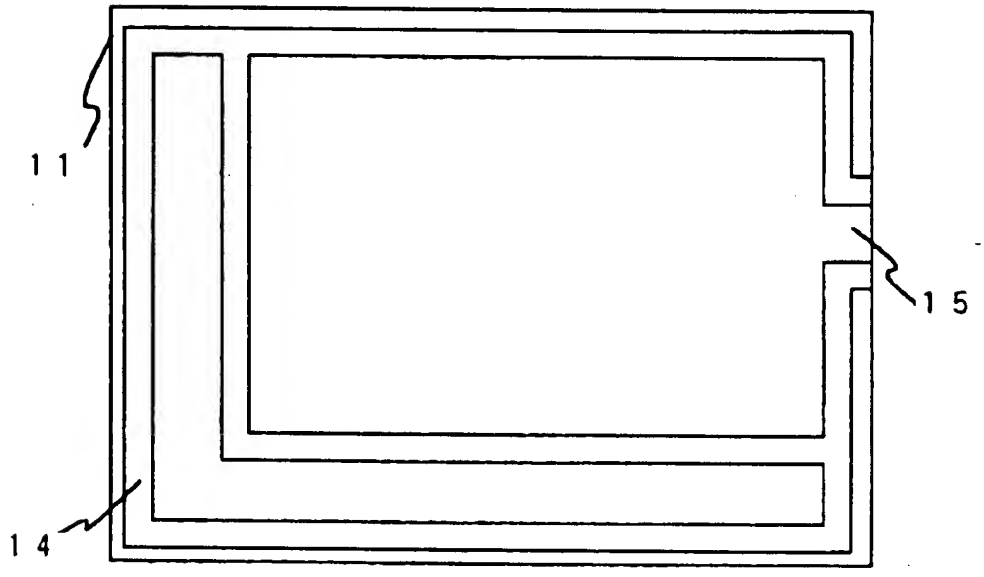

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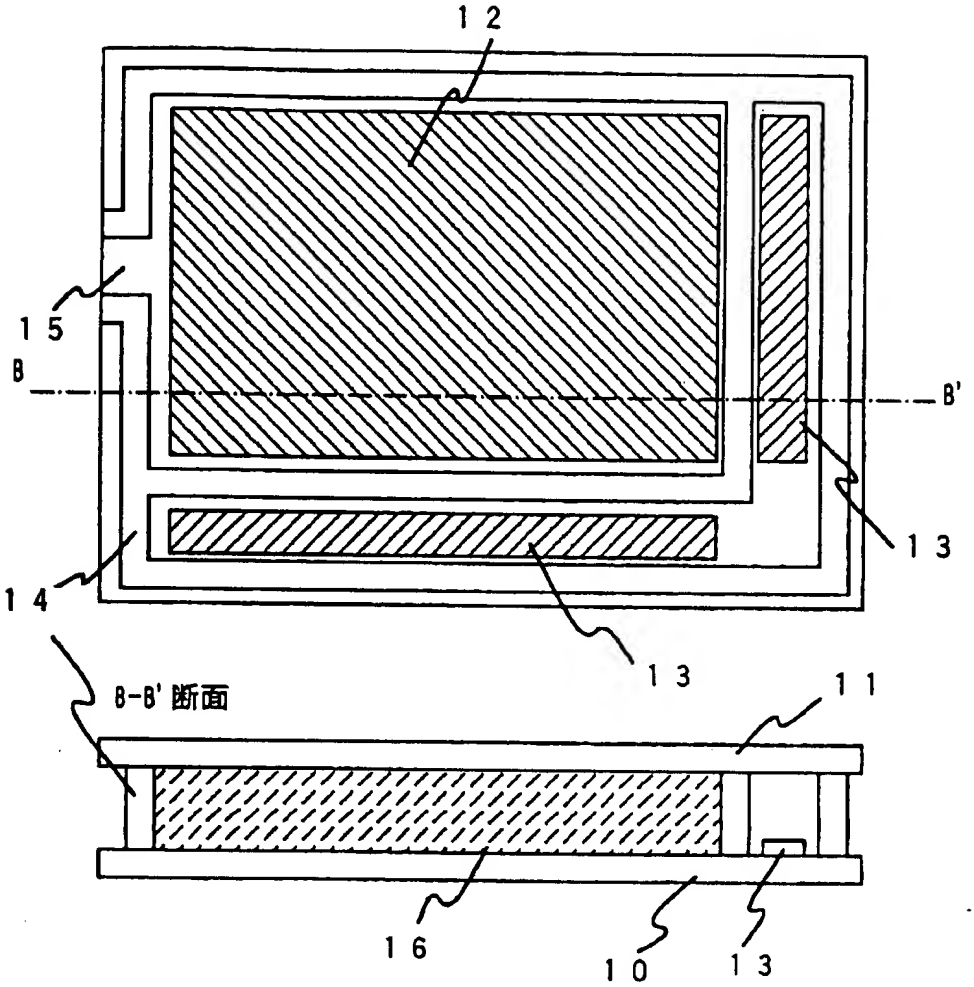

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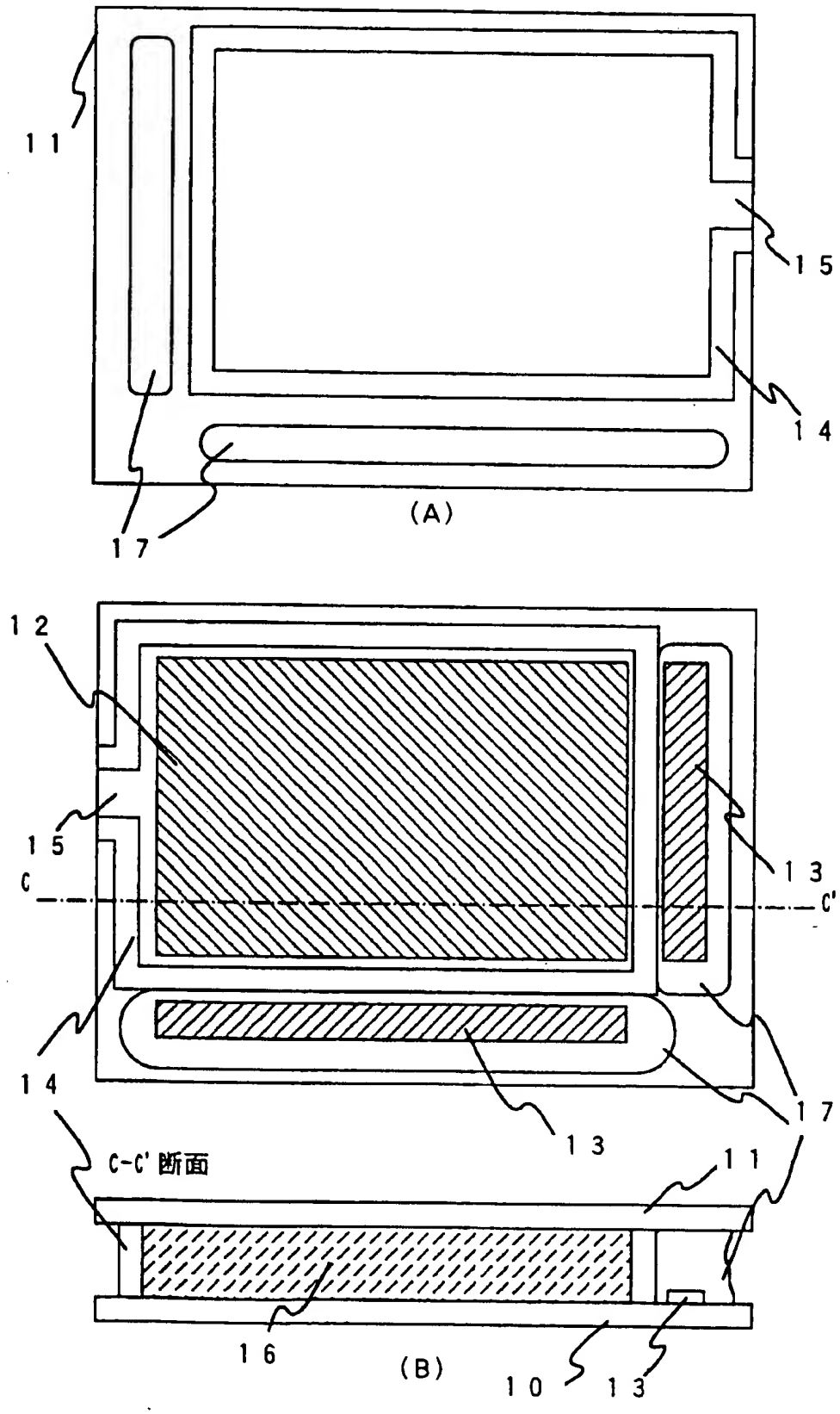

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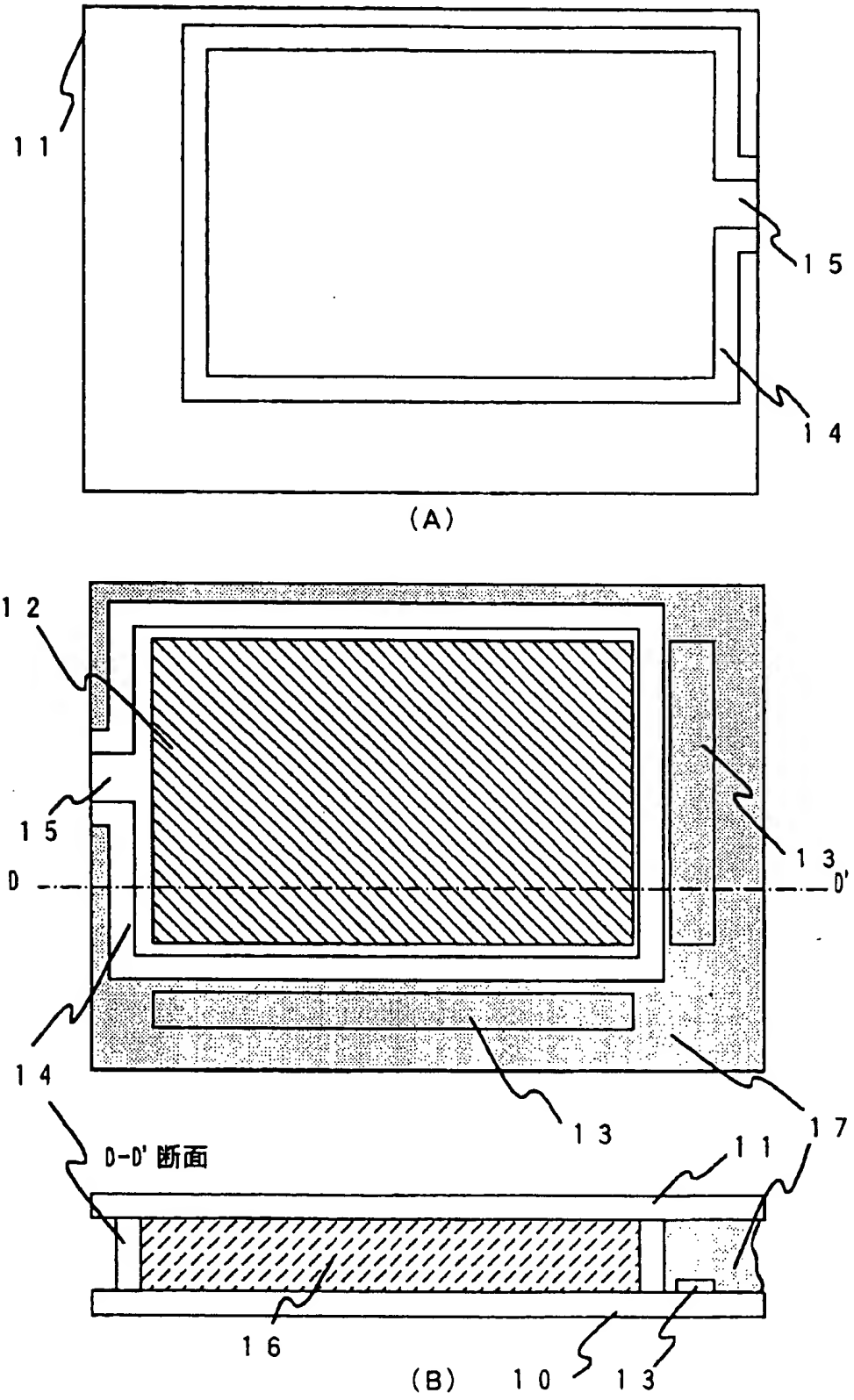

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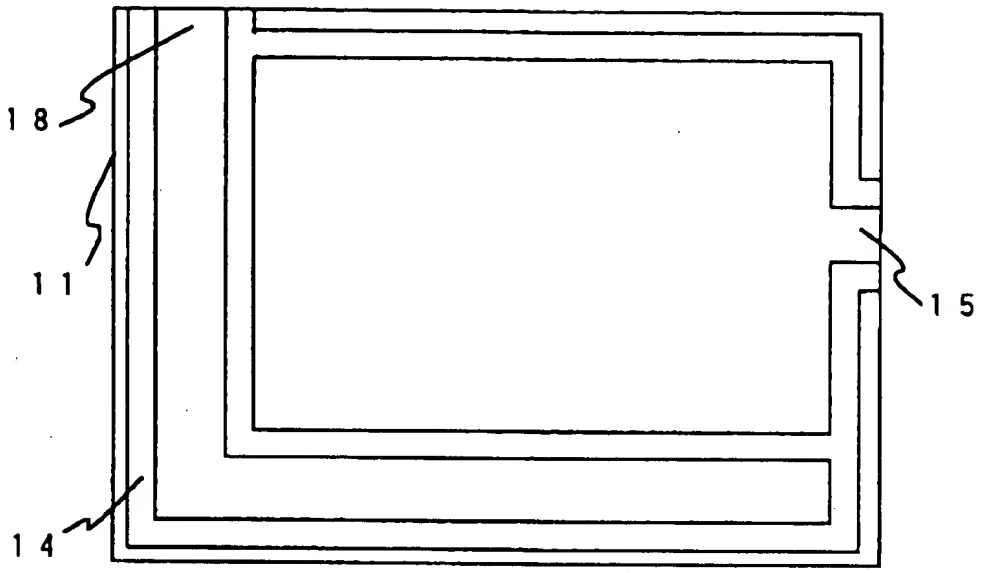

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